Sinusoidal Waveform Construction

Coil Angle (θ)	0	45	90	135	180	225	270	315	360
e = Vmax.sinθ	0	70.71	100	70.71	0	-70.71	-100	-70.71	-0
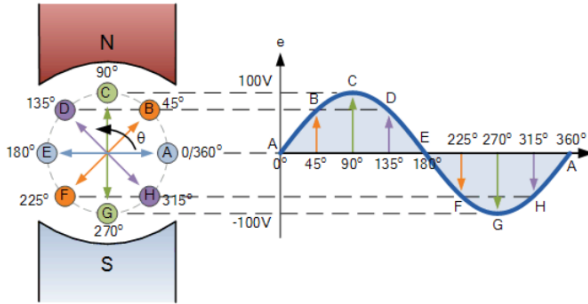
In the above picture the peak voltage is 100 so the RMS voltage is 70.7V.

So to make the maths easier at the peak lets use 140V as the peak and 100V as the RMS.

We will use a resistive load of 14 ohm to the AC generator which has a peak current of 10A. To determine the instantaneous voltage anywhere on the sinewave we can use Vi = Vmax x SinØ . Likewise we can express the current at the 22.5 degree increments and then the Power increments

Ø	0	22.5	45	67.5	90	
Vinstantaneous	0V	53.6V	99V	129V	140V	B
Tweaked V	0	54V	100V	130V	140V	C
Iinstantaneous (14R)	0	3.86A	7.14A	9.3A	10A	D
Tweaked Iinst	0	4A	7A	9A	10A	E
Tweaked Pwrinst	0	216W	700W	1170W	1400W	F
Pri peakVinst		16V	30V	39V	42V	G
Iinst from 48V		4.5A	14.5A	24.375A	29.16A	H
DC48V in Choke Inst current		11A	22A	27A	32.5A	I
Graph Plots on next page		Fig1	Fig2	Fig3	Fig4	

Note: first data row header cell reads "A".

Assume pri voltage 30V RMS therefore peak 42.5 – yes can be supplied from 48V.

Transformer ratio 1:3.33 for 100V RMS out from 30VRMS primary

In the above WORKED example for a power of 700WRMS the instantaneous peak choke current is 32.5A

However lets assume inverter and components are 100% efficient the 48V current input will be 14.6A

The ratio from 32.5A to 14.6A is 2.22 times greater.

In my given example in the opening post, the ratio after adding 15% extra peak inductor current, was 325 to 120A which is 2.7 times. The peak inductor current does not add 15% at the peak it is only ~ 10%. I believe the analysis presented here is much closer to being correct at ~ 2.22 times the DC equivalent input current.

So Nicks, here it is with buck regulator topology and worked examples at various points in the cycle.

BTW I first coined the phrase in these columns that the inverter can be modelled as an overgrown buck regulator with synchronous FET flywheel diode fed with a modulated 50Hz reference – I still think this holds true !

I believe my initial calculations were not too far from the worked results here. Please see the buck regulator waveforms on the next page showing a 40uH choke with various real current & voltage measurements plotted.
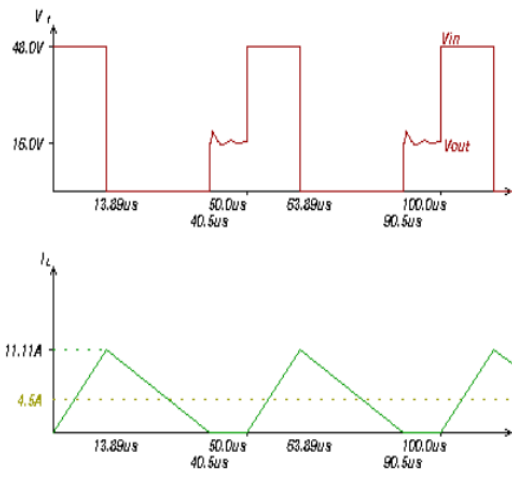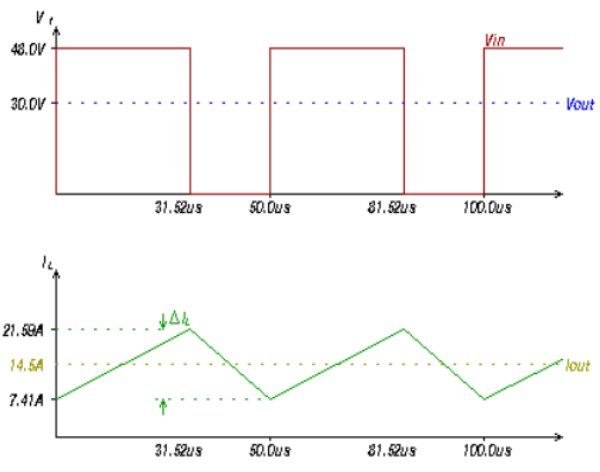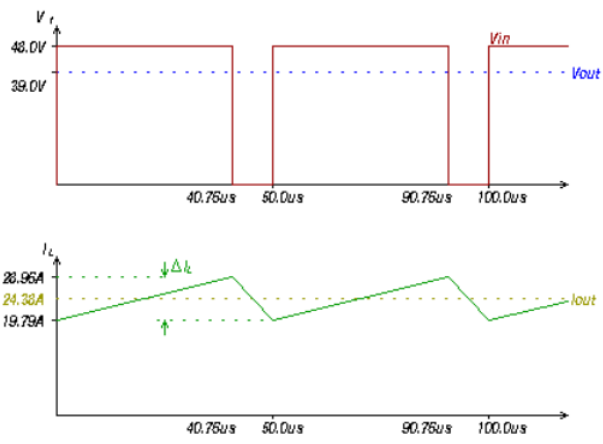
Fig1

V t
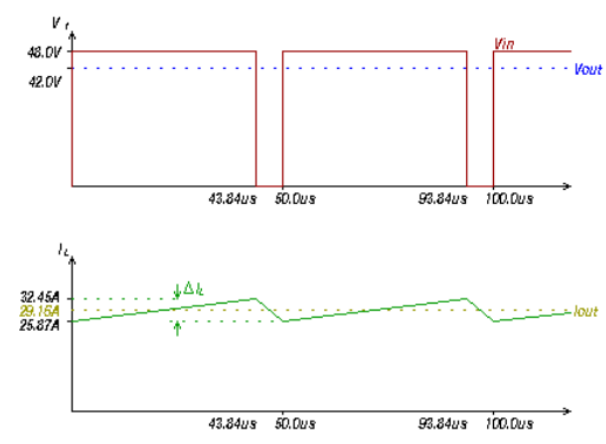48.0V
15.0V — Vin
Vout
13.89us   50.0us   53.89us   100.0us
40.5us   90.5us

I_L
11.11A
4.5A — Ia
13.89us   50.0us   53.89us   100.0us
40.5us   90.5us

Fig2

V t
48.0V — Vin
30.0V — Vout
31.52us   50.0us   81.52us   100.0us

I_L
21.59A   ↓ΔI_L
14.5A — Iout
7.41A   ↑
31.52us   50.0us   81.52us   100.0us

Fig3

V t
48.0V — Vin
39.0V — Vout
40.76us   50.0us   90.76us   100.0us

I_L
28.96A   ↓ΔI_L
24.38A — Iout
19.79A   ↑
40.76us   50.0us   90.76us   100.0us

Fig4

V t
48.0V — Vin
42.0V — Vout
43.84us   50.0us   93.84us   100.0us

I_L
32.45A   ↓ΔI_L
29.16A — Iout
25.87A   ↑
43.84us   50.0us   93.84us   100.0us